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METHOD AND APPARATUS FOR DISPLAYING 3-D STATE INDICATORS

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Related Applications

This application claims priority to U.S. Provisional Serial Numbers 60/241,049 and 60/241,051 both filed October 17, 2000. Further, this application is a Continuation-In-Part of co-pending U.S. Serial Number 09/949,101 entitled "Network Management System Using Virtual Reality Techniques to Display and Simulate Navigation to Network Computers" filed September 7, 2001. This application is further related to co-pending U.S. Serial Number. 09/558,897 entitled "Method and Apparatus for Predictively and Graphically Administering a Networked Computer System in a Time Dimension" filed April 26, 2000, and U.S. Serial Number 09/559,237 entitled "Method and Apparatus for Maintaining Data Integrity Across Distributed Computer Systems " filed April 26, 2000. Each of the previously mentioned applications is hereby incorporated by reference in its entirety. The concurrently filed U.S. Non-Provisional Application entitled "Method And Apparatus For Displaying 3D State Indicators" is also incorporated herein by reference.

Technical Field

The present system is in the field of systems and articles of manufacture to administer and analyze complex, heterogeneous networked computer systems and other systems that can be monitored by computer technology. More specifically, the present system is directed to systems and articles for enabling user selection and presentation of a property of an object in a three dimensional graphic display.

Background

In known system management applications, the visualization of the contents, configuration, and state of the managed system is usually based on some form of display, ranging from a list of items, to icons arrayed in some meaningful way, to 2-D diagrams, to 3-D views. The type of each object may be indicated with an icon of some sort, while the identity and/or state of the object is often rendered in text form. Variations on these themes exist, such as displays that are completely textual and those that use no text at all, but common to all such systems is a core display that shows the objects under management and their relationships.

Using 3-D visualization to render objects conveys a more realistic view of managed objects and their configuration. However, one problem with such a technique is that system management applications typically only show 3-D images of the basic description of the objects, such as their type and inter-connectivity. Another problem is that common system management applications only show fixed properties of the managed objects.

To show the general state of the managed objects, which may include values of their properties, such as state, load, error rate, integrity, and available capacity, known systems typically use some form of visualization appropriate to the metrics of interest. For example, to show the status of the object, an indicator of its essential health, ranging from NORMAL to CRITICAL and also taking on values such as UNKNOWN, it is common to use color, where green might indicate NORMAL, red might indicate CRITICAL and gray or black indicate UNKNOWN.

In real-world displays, it is not practical to surface all the information about the managed object in this core 3-D display. Although some applications have attempted to do this by displaying textual information on planes in 3-D, such displays are harder to read than plain 2-D text because of the limited resolution of current equipment and because current systems do not have enough computational power to anti-alias text or other graphical elements in real time. If this much information is desired, using a 2-D visualization model is considered superior. The benefits of 3-D views appear to be best gained by employing 3-D metaphors.

Some systems generate 3-D bar charts, usually standing on a plane in a regular grid. However, these bar charts have many problems. Most notably, the bars appear to be standing on a totally abstract floor plane, not one that represents the real-world objects interconnected through network links. In addition, such general charting systems are based on collected statistics, and not on real-time monitoring measurements coming out of a management system.

In order to show the other very important and detailed information about the managed objects in a practical way, it is commonplace to provide some mechanism for "drilling down," thereby retrieving more detailed information about the object from an information store, using a conventional user interface. For example, in network and systems management systems, it is common to surface status in the core display but provide performance and load indicators in other displays that may be brought up from the core display.

Unfortunately, these arrangements have some disadvantages. When additional information is brought up in secondary displays, the secondary displays deviate from the normal navigation conventions of the core 3-D display. In this situation, to see the secondary data on various management objects, it is necessary to first navigate to them, then bring up the secondary display, then navigate to other objects and bring up their secondary displays. Using such an interface is not only cumbersome, but it also impedes a user's ability to compare properties of several objects at once.

In addition, fixed arrangements of this type may not suit every user. For example, while many users may be primarily interested in status and consider load secondary, the person in charge of managing load balancing across the network may be more interested in instantaneous load displays.

Some system management applications provide for customizing the display in two areas. The information displayed in conjunction with the icon in typical displays may be selected from the properties of the objects, so that the icon shows various pieces of information in the form of text, color or other ways. Alternatively, moving the mouse cursor over a symbol in the display may bring up a configurable reticule with labeling, again displaying different properties. This customization is often done specific to each class of object, so different information is displayed about a server and a router, for example. However, this type of configuration is typically static, requiring the user to enter some sort of configuration utility. No known system provides a real time configuration of the display.

Summary

In accordance with the disclosed system, a first method for presenting a status of an object in a three dimensional graphic display is disclosed. The method includes the step of determining a value of a property associated with an object. The method further includes the step of determining a status indicator associated with the property. A status indicator is then generated representing the property associated with the object, and displayed relative to the associated object.

In accordance with the disclosed system, a second method for presenting a user selected status of an object in a three dimensional graphic display is disclosed. The method includes the steps of receiving a request to select a property of an object for display and displaying at least one

property which may be displayed for the object. The method further includes the step of receiving a selection of a property. The value of the selected property for the object is determined and a status indicator is generated based on the value of the selected property. The status indicator is then displayed relative to the object.

The objects, features and advantages of the disclosed method and system are readily apparent from the following description of the preferred embodiments when taken in connection with the accompanying drawings.

Brief Description of the Drawings

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings in which like reference numbers indicate like features and wherein:

Figure 1 illustrates a system according to a preferred embodiment of the present system;

Figure 2 illustrates a display of the representation of a networked computer system or complex business operation according to a preferred embodiment of the present system;

Figure 3 illustrates a section of the display in Figure 2 with an additional information display according to a preferred embodiment of the present system;

Figure 4 illustrates a section of the display in Figure 2 with an additional information display and user interface according to a preferred embodiment of the present system;

Figure 5 illustrates a section of the additional information display of Figure 3 according to a preferred embodiment of the present system; and

Figure 6 illustrates a flow chart of a method according to a preferred embodiment of the present system.

Detailed Description

The various components that comprise a preferred embodiment of the disclosed network analysis system are shown in Figure 1. The system includes one or more of a visualization workstation 101, an object repository 102, one or more management applications 103, and one or more agents 104 on each such management application. The visualization workstation 101 interacts primarily with the object repository 102. It requests information from it, it sends commands to it, and it gets notification of events such as status change or object additions from

it. The repository 102 in turn gets this information form the various management subsystems 103, which are fed by agents 104 on the managed systems. An important architectural consideration of the present system is that in normal operation, the visualization workstation 101 preferably interacts with the object repository 102. This minimizes network traffic, optimizes the performance of the rendering of the workstation, and minimizes the interconnectivity between the visualization workstation 101 and the multitude of management subsystems and agents existing in practical networks.

Preferably, the management system is based on some type of store, preferably the object repository 102, that holds the description of the structure of the network. This can include the momentary state, load, and performance of the network and the systems. This store may or may not be persistent, it may be populated with a manual process, or with an automatic discovery utility.

According to a preferred embodiment of the present system, as shown in Figure 2, a management system outputs a display 202 of the managed objects using 3-D models 204 of real-world objects, configured in suitable positions over 3-D sections 208 of a 3-D surface, and interconnected with at least one line 206 that shows a network link, where optional links are shown as dots and dashed lines. The status of each object 204 is indicated with a hovering light 212, whose color indicates status from green through yellow, orange and red. The status of network link 206 may be indicated by coloring the link itself.

Turning to Figure 3, a more detailed view of the display 202 in Figure 2 is shown. As seen in Figure 3, according to a preferred embodiment of the present system the system generates additional objects 302, such as a vertical bar, next to each representation 204 of a "real-world" object. The present system uses these additional objects 302 to indicate in real time quantitative or qualitative measures of the managed objects.

As seen in Figure 4, an alternative preferred embodiment includes an indicator section 302 that displays other indicators in the core display 202. In this and other alternative preferred embodiments of the disclosed system, the indicator section 302 can include color, animation effects, icon choice, text, bar, line or pie charts near the managed object, and others. The managed objects 204 have a set of properties, some numeric, some textual, and some categorical. Current system management applications support surfacing some fixed set of properties in the

core display using fixed indicators, but other properties must be brought up through an explicit request, after which they are visualized using a technique determined by the application.

To overcome these problems, the preferred embodiment of the disclosed system provides an interface 304, preferably a property selection control panel, that permits a user to select properties the user desires to monitor in the indicator section 302 using predetermined indicators. In other embodiments, the user may select a type of indicator to be used from a menu of indicators, such as for example bar graph, indicator light and pie chart.

A user can interact with interface 304 by point-and-click operations after placing a cursor 306 over a box 308, or any similar configuration or arrangement, in the interface 304. After clicking on the box 308, the area chosen by the user is correlated to a predetermined property to be displayed X_n through X_{n+m} 310, where n and m are integers. In use, X_n through X_{n+m} are textual representations of the available properties. Thus, in the preferred embodiment of the disclosed system, the indicators 310 are the actual textual names of the properties chosen. Preferably, all properties, are visualized in a standard way after being explicitly requested, so there is no need for customization of the secondary displays.

In the preferred embodiment, after a user interacts with the control panel 304, there is an immediate effect to the indicator section 302 in the display 202, without requiring any complex settings in a dialog box, a confirmation dialog, or even pressing an OK button, which would break the flow of the operation and distract the user from the information displayed.

Further, the property selection control panel 304 preferably acts as an indicator of what information is currently displayed. In the preferred embodiment, distinct indicators for the various types of information are used through bars 312, preferably a yellow-orange-red color range indicates status and shades of blue indicate load. In this way, a knowledgeable user can immediately tell, by looking at the control panel 304 in the display 202, what information is currently displayed. In the preferred embodiment, the control panel 304 shows the current indicators, such as colors or animation effects, as well as the corresponding property, identified by name. Providing both a textual description of the properties and their corresponding visual displays in control panel 304 assists a novice user who may know the meanings of the various visual displays employed by the system.

For example, as seen in Figure 5, to indicate the real time percentage load of a computer system, the additional object 302a can be a solid bar 304 that reaches up to a corresponding

percentage within an empty, transparent bar. In some ways, this resembles a conventional bar chart, with the percentage scale 306 on an x axis above the bar 304, but combined with a 3-D display 202 of real-world objects that are arranged in a way that represents the real-world configuration of these managed objects.

According to a preferred embodiment of the present system, indicator 302 is made translucent. This avoids making the visualization 302 unreadable due to the large number of objects 204 and their quantitative indicators 302, such as the bars 304. The effect is that of "colored water" reaching up to a certain level in a "glass aquarium tank." The colored area that represents the actual traffic load or performance is colored fairly solidly, just translucent enough to indicate the distinction between this quantitative measure and the real-world objects, and to prevent the quantitative measures from obstructing the view of other objects. The empty part of the tank, representing capacity of the system that is currently not exploited, is almost entirely transparent, rendered just opaque enough to give an impression of a glass tank.

In addition, in alternative preferred embodiments of the present system, the system uses other advanced visualization techniques, such as reflections in the "glass surfaces" and the "edges of the glass tank" to increase the perceived realism and reduce the visual clutter between the managed objects 204 and the quantitative indicators 302.

In Figure 6, a preferred method 600 is shown. The method starts at 602, after which a request is received to select a property of an object to be displayed at 604. This request is preferably initiated by a user indicating that the user wishes to customize the display, for example by double-clicking on an object or by .right-clicking on an object and making a menu selection.

At step 606, the property selection control panel is displayed. The control panel contains at least one property which may be selected for display. A selection of a property from the control panel is received at step 608. The value of the selected property for the object is determined at 610. This determination is preferably performed in real-time with reference to data contained in object repository 102. A status indicator is generated based on the determined value of the selected property at step 612, and the status indicator is displayed at step 614.

Accordingly, it is to be understood that the drawings and description in this disclosure are proffered to facilitate comprehension of the system, and should not be construed to limit the

scope thereof. It should be understood that various changes, substitutions and alterations can be made without departing from the spirit and scope of the system.